Integrated Modeling Workshop

Interferometry Missions -- Integrated Modeling Needs

Robert A. Laskin
Manager, Interferometry Technology Program
Jet Propulsion Laboratory
Pasadena, CA

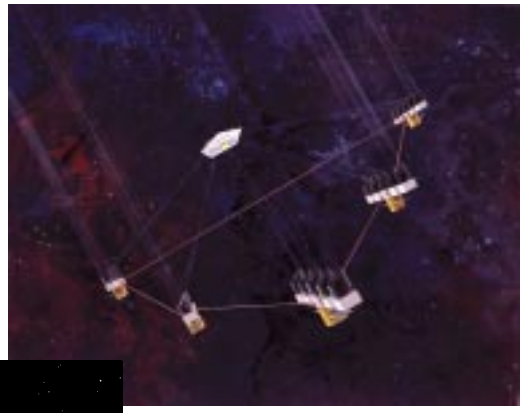
19 January 1998

IMOS Historical Perspective

- Need for integraed modeling of optical systems initially recognized (within JPL) in the mid-’80’s while working on laser beam relay concepts for SDIO
- Greater impetus when the CSI Program adopted a Focus Mission Interferometer (1989) to drive technology development
  - Initial development of COMP (Controlled Optics Modeling Package)
  - Later commercialized as MACOS
- Initial funding for IMOS under JPL Director’s Discretionary Fund
- IMOS has been used internally at JPL on numerous programs
- Broadbased use throughout the community now becoming widespread

Interferometers: Instruments Critical for NASA's ORIGINS Program

Planet Imager --2020??

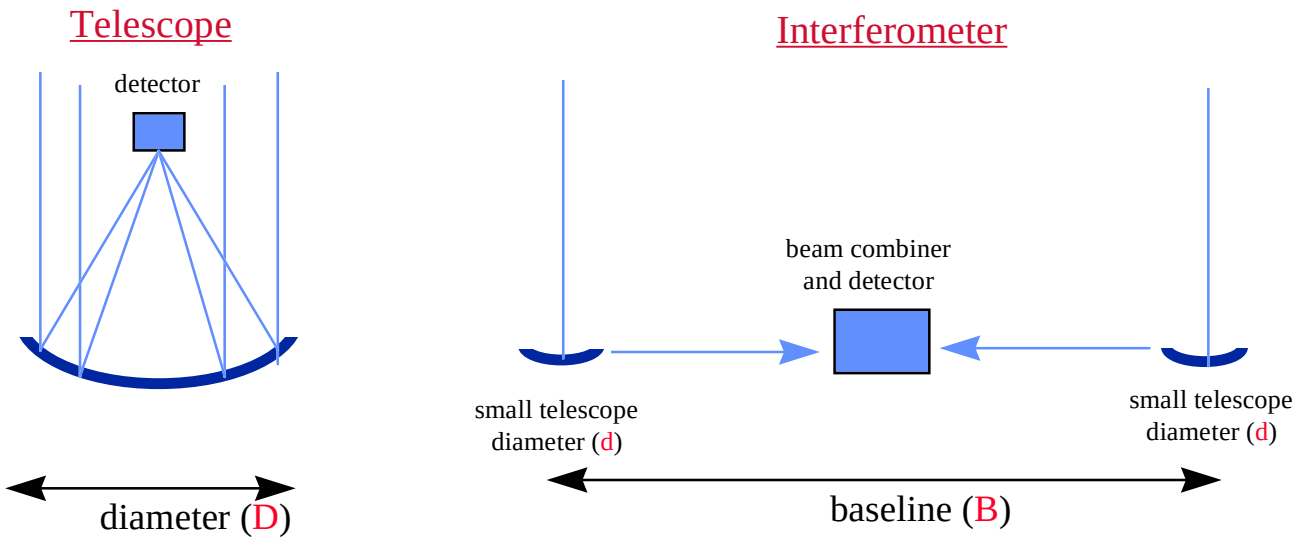


Terrestrial Planet Finder (TPF) -- 2010

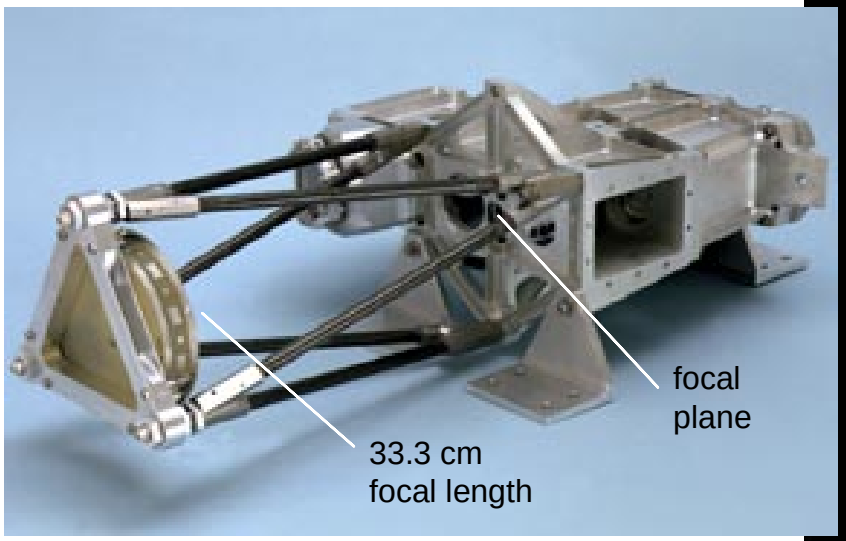
Space Interferometry Mission (SIM) -- 2005

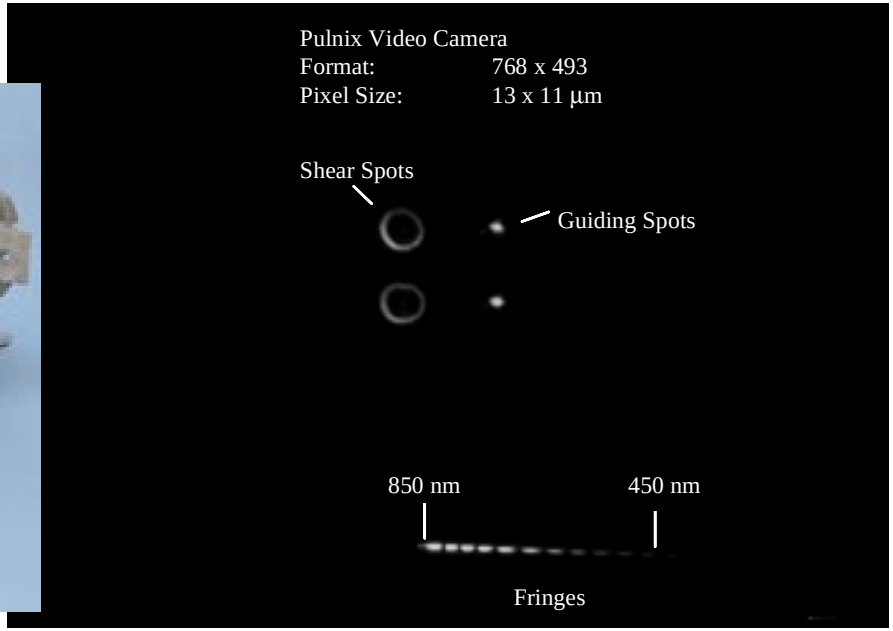
Keck Interferometer -- 2000/2001

What Is An Interferometer?



An interferometer combines the light from several small telescopes to yield the angular resolution of a much larger telescope

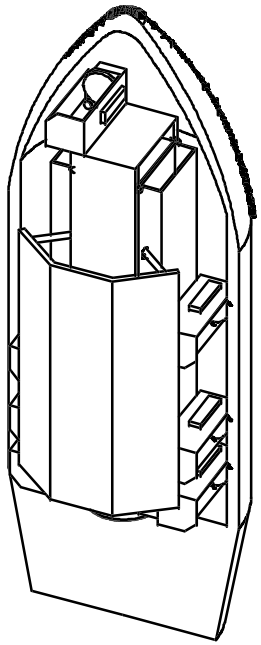


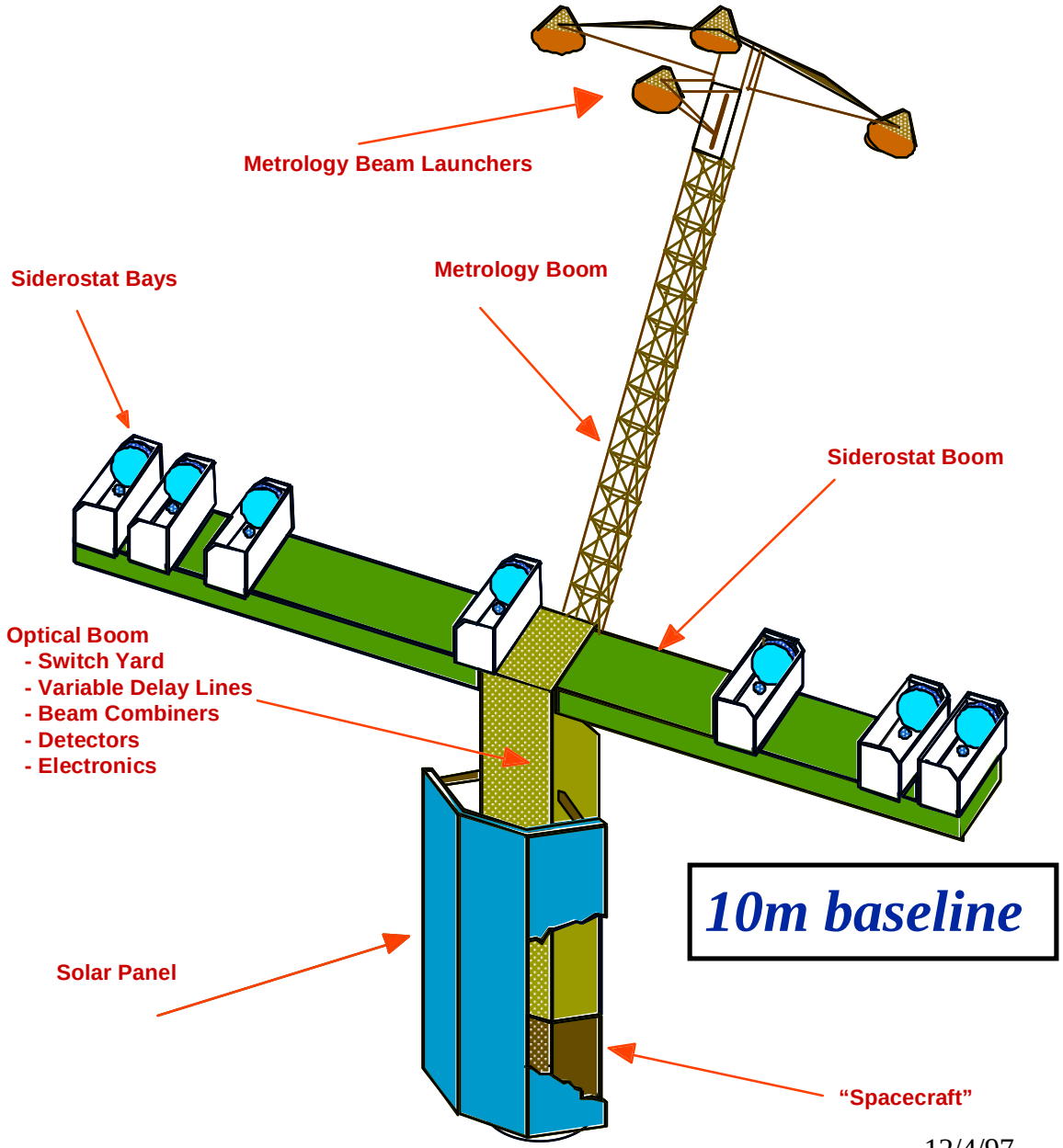


R. Laskin

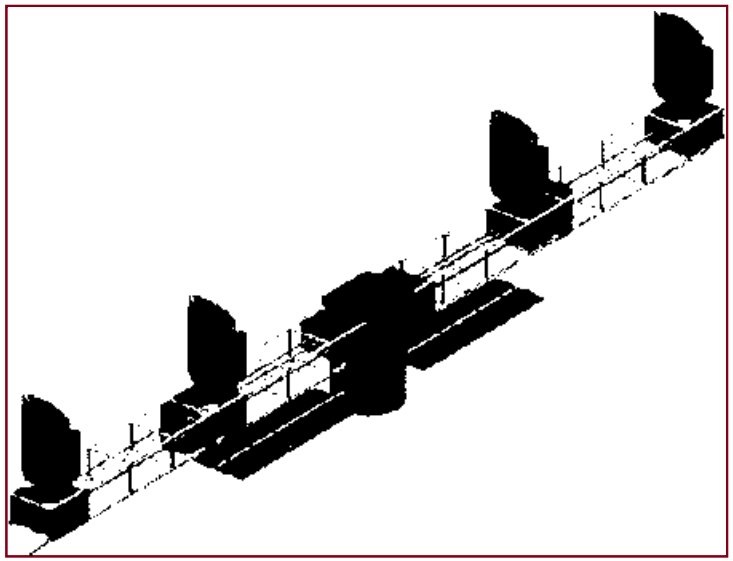
Space Interferometry Mission (SIM)

SIM in Stowed Configuration

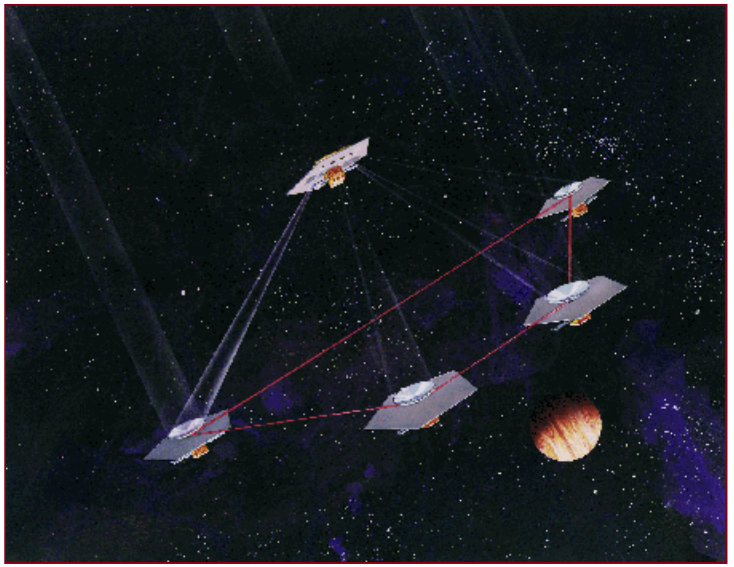




Terrestrial Planet Finder (TPF) Concepts



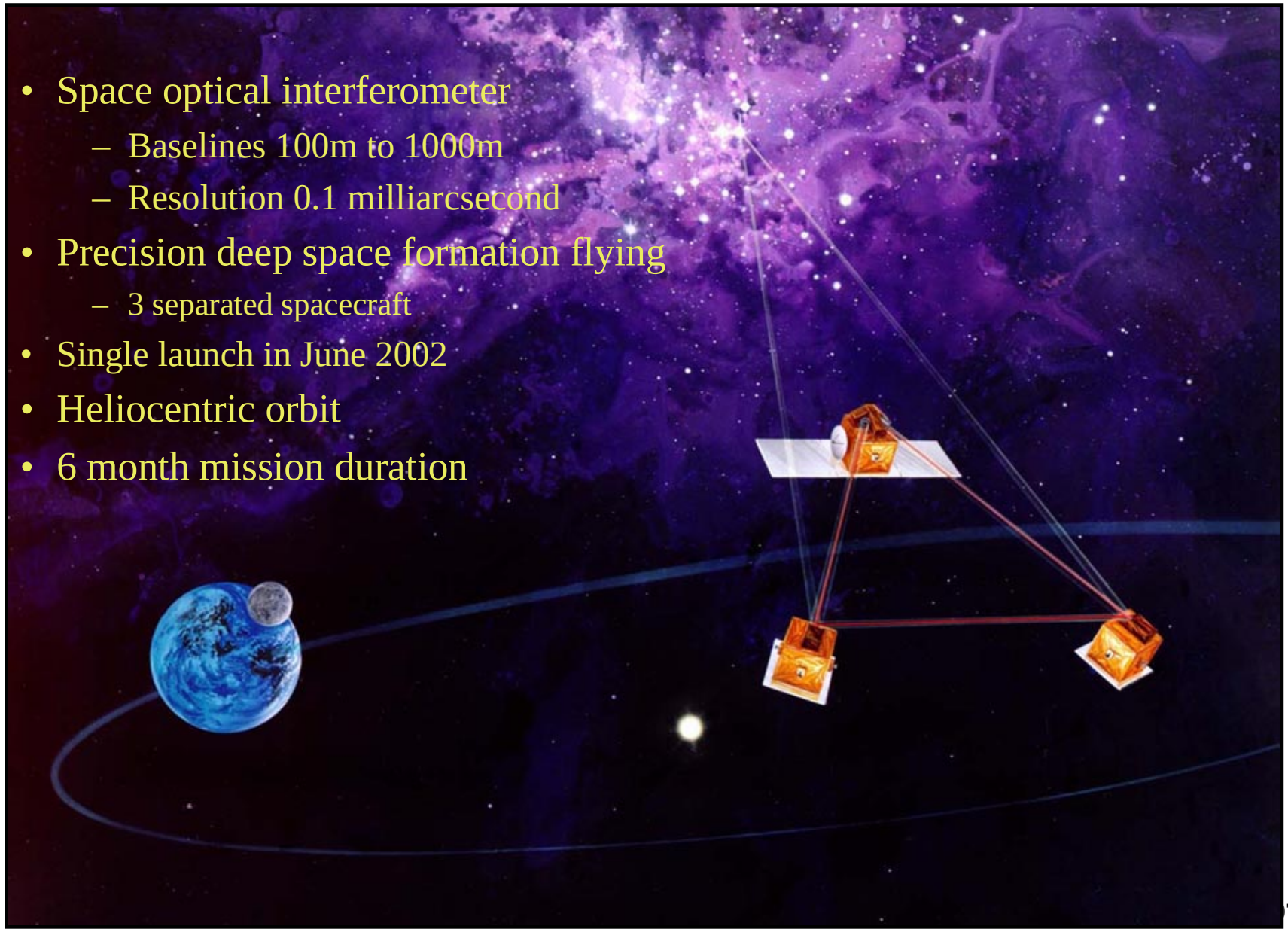
Physical Baseline



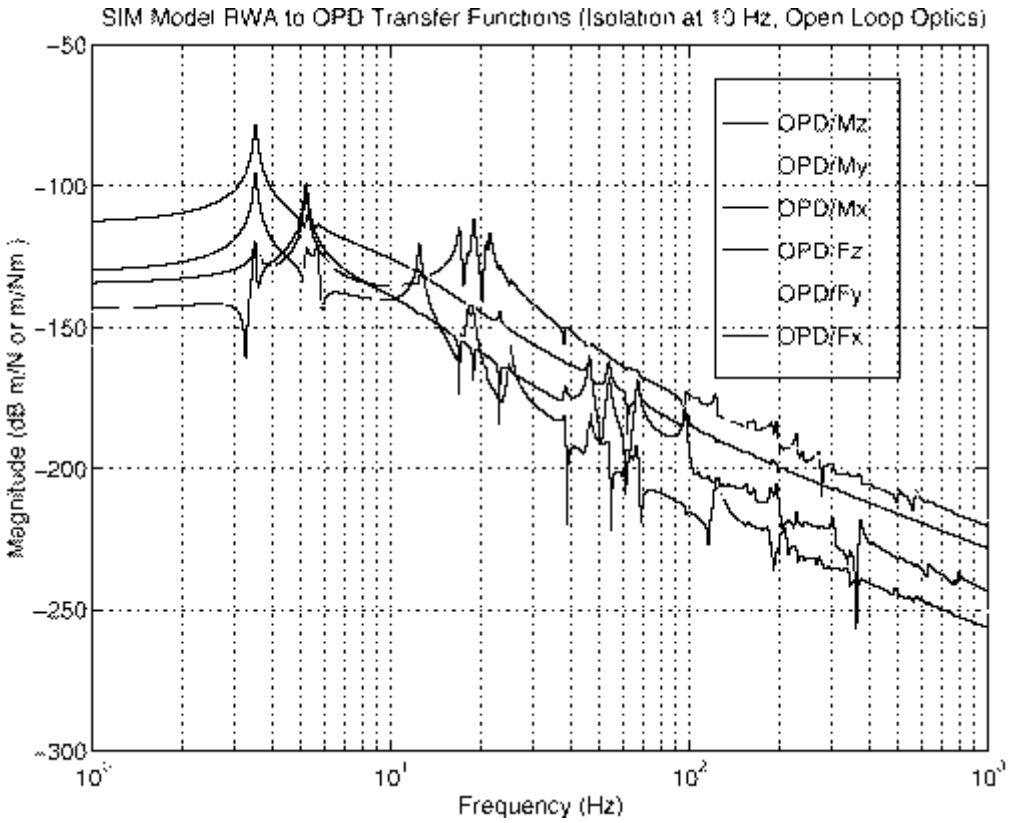
Virtual Baseline

- ***75-150m baseline***
- ***4-6 telescopes (1.5-2m aperture)***
- ***7-17μm observations***

New Millennium DS3 Mission

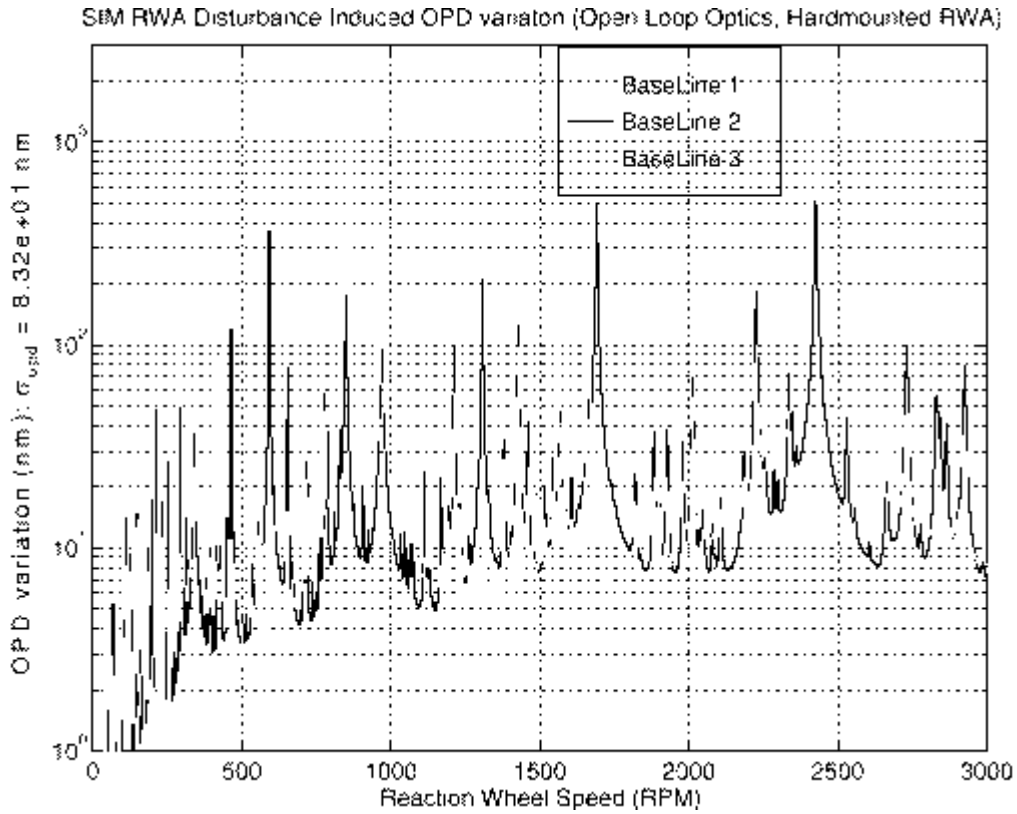


RWA Disturbance to OPD Transfer Function



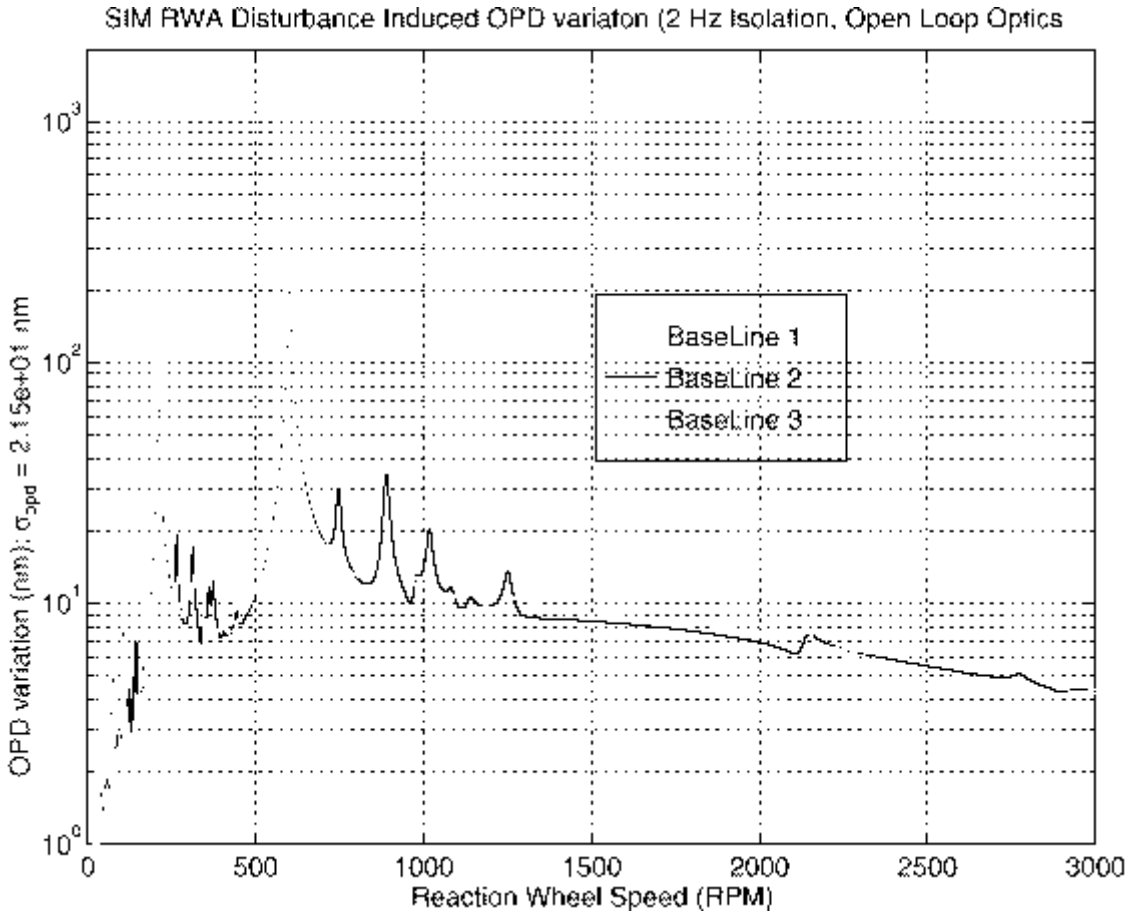
RWA Disturbance Induced OPD Variation

(Hardmounted RWA, Active Optics Loops Open)



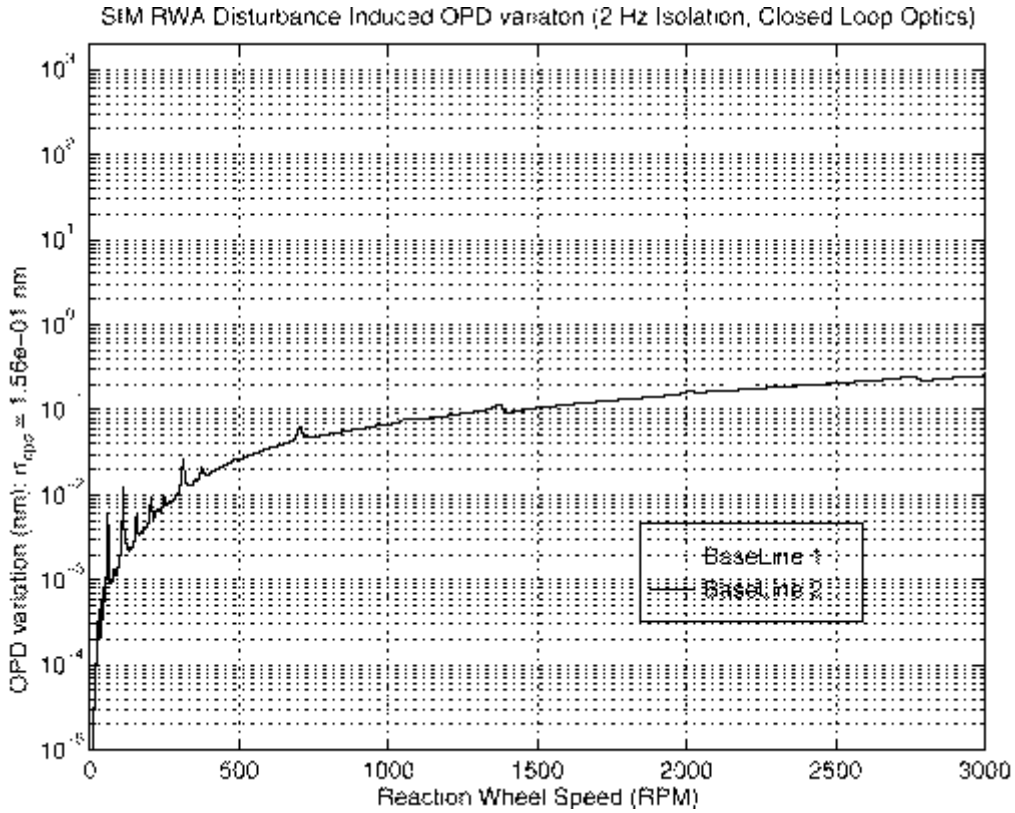
RWA Disturbance Induced OPD Variation

(2 Hz Isolation, Active Optics Loops Open)



RWA Disturbance Induced OPD Variation

(2 Hz Isolation, Active Optics Loops Closed)

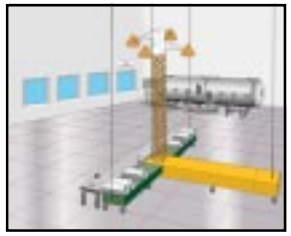


Interferometry Testbeds

Mt. Wilson Interferometer

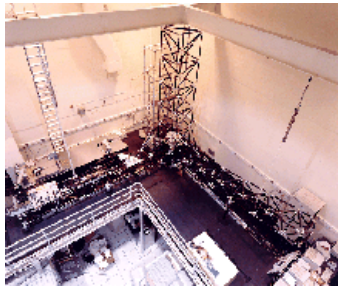
Palomar Testbed

Microarcsecond Metrology



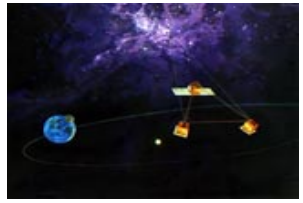
SIM System Testbed

SIM



MPI Testbed

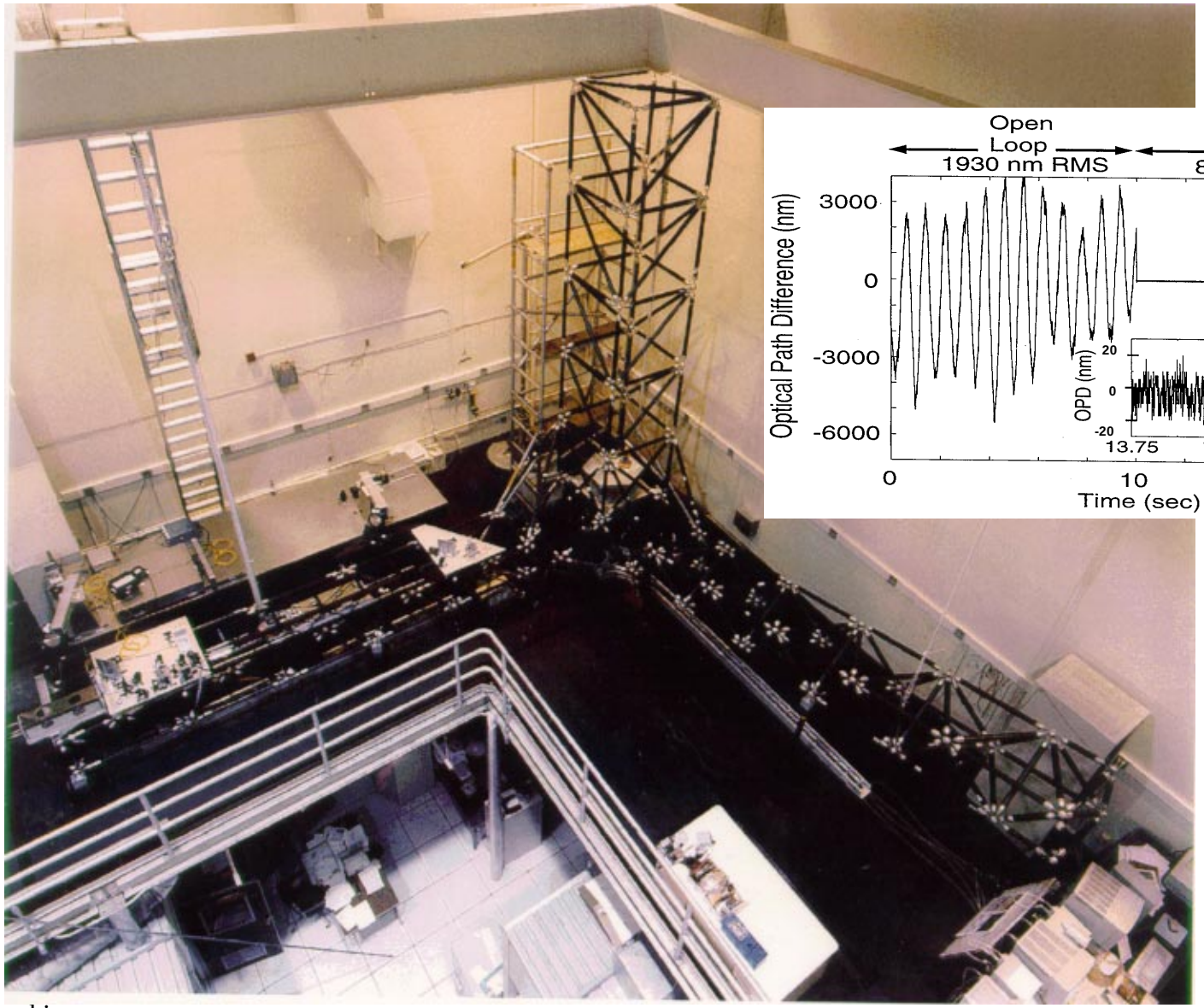
Keck



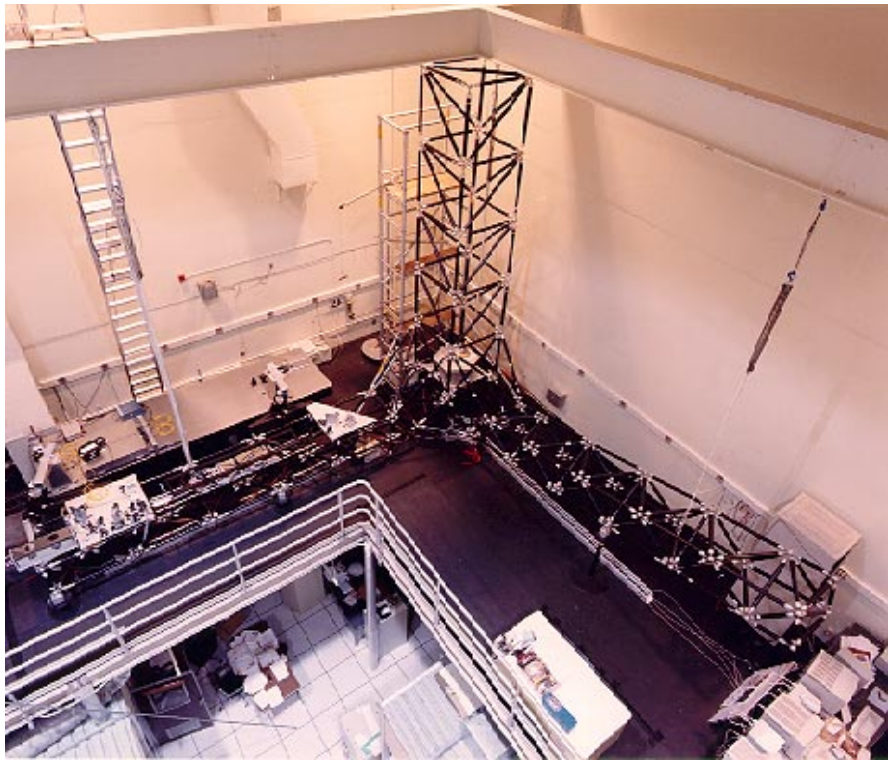
DS-3

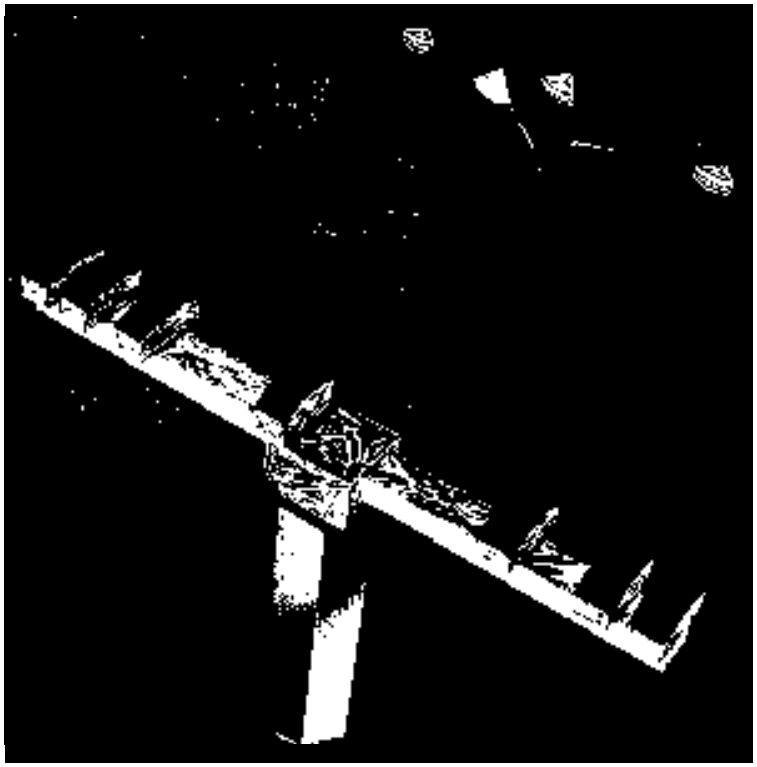
1990 1995 2000 2005

Micro-Precision Interferometer (MPI) Testbed



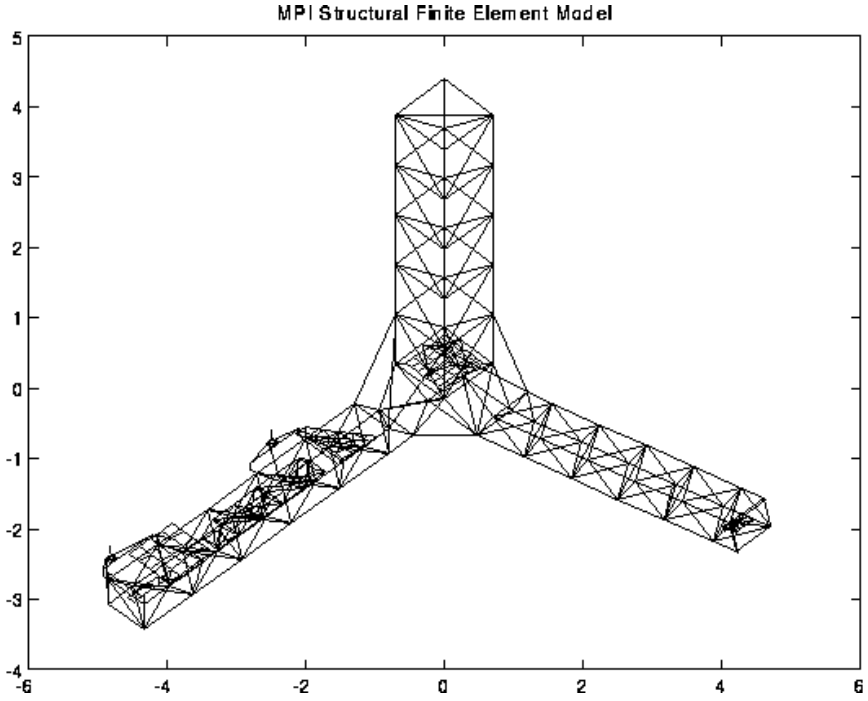
Where Does Modeling Come In?

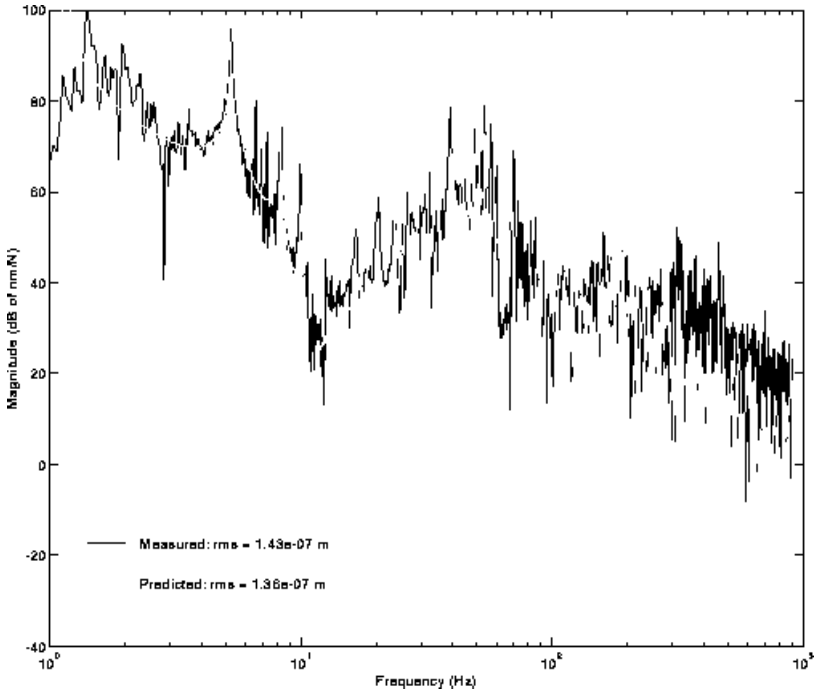




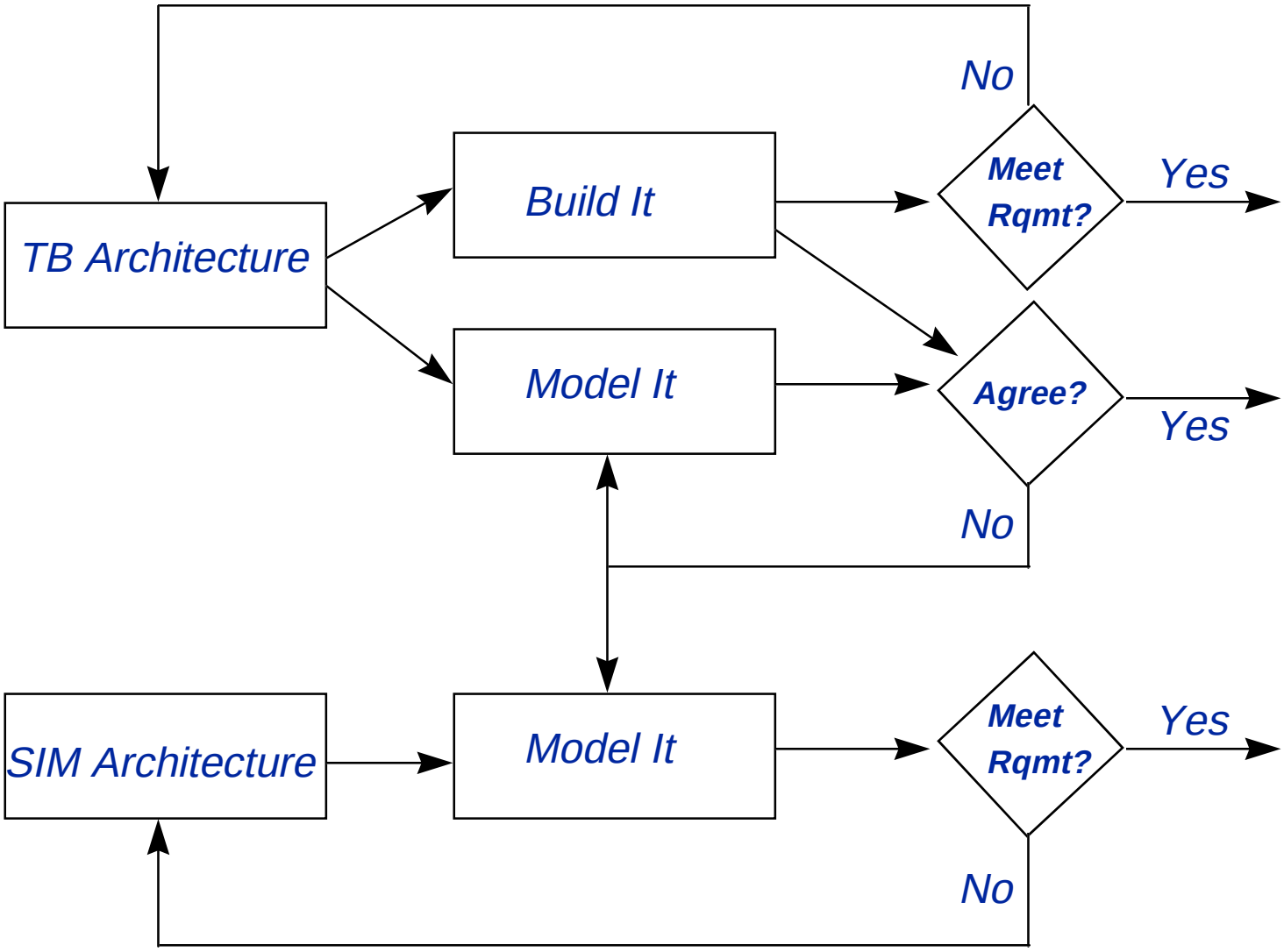
THE TESTBED IS NOT THE FLIGHT SYSTEM

Validation of IMOS on MPI





Testbed Modeling and Flight System Modeling



Interferometer Integrated Modeling Needs

- Types of analyses
  - Fringe stability vs mechanical disturbance input
  - Tip/Tilt stability vs mechanical disturbance input
  - Wavefront stability vs thermal loads
  - Slew, settle, reacquistion simulations
  - Calibration modeling and simulation
  - Emulated science data stream vs error source (mechanical, thermal, alignment, calibration, ...)
- Types of modeling capabilities
  - Mechanical disturbance modeling
  - Thermal disturbance modeling
  - Optical modeling
  - Structural modeling
  - Thermal modeling
  - Control system modeling
  - Orbit and attitude modeling

Interferometry Based Quantitative Requirements

- We have not really done this .... but it would sure be a good idea

- Examples
  - Size of structural (thermal, optical, ...) model in need of crunching
  - Desired runtime vs DOF
    - On workstation A
    - On personal computer B
    - On supercomputer C
    - On massively parallel supercomputer D

SIM Top Level Schedule